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MECHANISMS OF SEIZURE SUSCEPTIBILITY AND EPILEPTOGENESIS

Seizure-induced basal dendrites on granule cells

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SUMMARY

Seizure-induced hilar basal dendrites on dentate granule cells are observed in several rodent models of temporal lobe epilepsy. Ultrastructural evidence showed that basal dendrites receive predominantly excitatory synapses, including many from mossy fibers. Such highly interconnected granule cells with basal dendrites are suggested to enhance hyperexcitability within the

dentate network. For an expanded treatment of this topic see *Jasper's Basic Mechanisms of the Epilepsies, Fourth Edition* (Noebels JL, Avoli M, Rogawski MA, Olsen RW, Delgado-Escueta AV, eds) published by Oxford University Press (available on the National Library of Medicine Bookshelf [NCBI] at www.ncbi.nlm.nih.gov/books).

KEY WORDS: Astrocytes, Doublecortin, Electron microscopy, Epilepsy, Excitation, Neurogenesis, Neuroplasticity.

Status epilepticus results in several neuroplastic changes to the granule cells of the hippocampal dentate gyrus. These include mossy fiber sprouting, granule cell dispersion, hilar ectopic granule cells, and hilar basal dendrites. Several rodent models of temporal lobe epilepsy display hilar basal dendrites on granule cells following seizures (Spigelman et al., 1998; Ribak et al., 2000). Electron microscopy of these basal dendrites showed that their spines and shafts are postsynaptic to many axon terminals, including those derived from other dentate granule cells (Ribak et al., 2000). These aberrant structural changes are associated with a predominantly excitatory input to granule cells because <10% of axon terminals forming synapses with basal dendrites were labeled for the inhibitory neurotransmitter, γ -aminobutyric acid (GABA) (Thind et al., 2008). Therefore, granule cells with basal dendrites are highly interconnected and may act as hubs for excitatory activity to enhance hyperexcitability in the dentate network. Granule cells with hilar basal dendrites were suspected of being newborn neurons based on their location at the hilar border where newborn neurons are added to the adult dentate gyrus. Doublecortin immunolabeling showed many basal dendrites on newly generated dentate granule cells and their persistence may be due to the rapidly forming synapses that integrate these granule cells

into synaptic circuitry (Shapiro et al., 2007). The development of hilar basal dendrites on granule cells occurs rapidly after seizures, as significant increases in the frequency of newly generated granule cells with hilar basal dendrites are found within 1 day after seizure induction (Shapiro et al., 2007). These basal dendrites may use hypertrophied astrocytic processes as guides to grow into the hilus. Together, these data provide insights into the anatomic and functional plasticity of rodent granule cells following seizures.

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DISCLOSURE

The authors declare no conflicts of interest.

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